FOREST HEALTH OF THE UNITED STATES' FORESTS

SECTION #1, PART # 1

WHAT IS FOREST HEALTH?

by the

Forest Health Science Panel

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PART #1

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WHAT IS FOREST HEALTH?

INTRODUCTION

"Forest Health" has been defined in different ways by different groups (Appendix A).

Terms and definitions in science are "shorthand" ways of discussing larger issues. Science deals with specifics, and terms with multiple definitions tend to obfuscate analyses, not clarify them. Consequently, a term with multiple definitions no longer becomes useful to scientists. Science usually deals with ambiguities of definition by defining a term at the beginning of a report (e.g., "For this report, 'forest health' will be used as defined by...[The scientist defines a reference.]").

A specific definition of "Forest Health" will not be selected or developed by the Panel. Rather, the Panel will discuss the present and potential ability of the forest to provide the various values different people want from the forest.

"Forest Health" conveys various concerns that people have of the forest's ability to provide a range of values. Various definitions of "Forest Health" (Appendix A) contain some or all of these values. The values can be divided into two types: values that a forest provides through its condition and functions, and values that are direct and tangible contributions of forests to the quality of human life. Some of these values are listed in Table 1.1.

Different values are provided simultaneously to various extents by each forest depending on its innate ecological characteristics, history, ownerships, and other factors. For the purposes of this discussion, the United States is divided into five regions (Figure 1.1): North, South, Inland West, Pacific Coast, and Alaska[1].

[1] These regions generally conform to the Resource Planning Act Assessments (e.g., Powell et al. 1993). The "Rocky Mountain" region of the RPA is referred to as the "Inland West" for this document. Eastern Washington and Oregon statistics are included in the "Pacific Coast", even though their ecological, silvicultural, and socioeconomic characteristics are more similar to the Inland West. Alaska is generally separated as an independent region because its large size may confuse its contribution to forest values if included within any other region. Where data does not allow Alaska to be separated, it is included in the "Pacific Coast."

I. VALUES EXPRESSED AS DESIRED CONDITIONS OF THE FOREST (TABLE 1.1A).

Sustaining growth of forests

Tree mortality occurs naturally from crowding as forests grow and from biotic and abiotic agents (e.g., insects, diseases, mammals, fires, wind, fire, and ice). There is a concern that there are areas of excessive tree mortality in certain regions.

Some degree of native insects and diseases and mortality from windstorms, mammals, and fires provide values such as nesting structures (snags and mistletoe "brooms") and food for wildlife. However, this value must be balanced against the concern that mortality reduces the amount of timber growth available for harvest (discussed later) and increases forest fuels. High fuel levels increase the risk of catastrophic forest fires, which cause wildlife populations to change dramatically, among other effects.

Periodically (or chronically in some cases), native and exotic insects and diseases reach epidemic proportions across forests and lead to various concerns. Catastrophic windstorms and fires also occur periodically. The epidemic insects, diseases, and windstorms can also lead to secondary catastrophes including forest fires. The concerns associated with these events include:

--they reduce the amount of structures for "closed forest" species (“dense,” “understory,” and “complex” habitats; Figure 1.3) for many decades afterwards;

--they eliminate or adversely impact standing timber, thereby causing an increase in timber imports or a shift to steel, aluminum, brick, or cement, or other materials associated with very high environmental impacts, discussed later;

--they reduce the ability of private landowners to profit from the sale of timber.

--they can reduce recreational opportunities, since forests with a high proportion of dead trees are dangerous and not always appealing.

Consequently, the concerns about sustaining growth can be subdivided into the following:

Minimizing levels of exotic insect and disease pests: Exotic insect and disease pests include: chestnut blight, Dutch elm disease, larch casebearer, white pine blister rust, hemlock woolly adelgid, gypsy moth, larch-poplar Melampsora rust, butternut canker, and many other insects and pathogens. Many of these pests were introduced by nursery stock and wood product imports from Europe and Asia at various times during the past 150 years.

Minimizing catastrophic levels of native insect and disease pests: Native insect pests and pathogens have generally existed at endemic levels in forests, with periodic increases in populations that reach epidemic levels. Serious native pests in different regions include: southern pine beetle, mountain pine beetle, spruce budworm, dwarf mistletoe, and fusiform rust. Weather and cultural conditions can be responsible for populations reaching epidemic levels.

Minimizing catastrophic levels of native mammals: Native mammal populations can become pests if their populations become so large that they spread diseases to people, threaten people physically, or dramatically alter habitats. Such mammals include bears, elk, deer, beavers, and pocket gophers. Weather and cultural conditions can also be responsible for these populations reaching epidemic levels.

Minimizing catastrophic fire events: All regions of the United States have the potential for catastrophic fires covering tens or hundreds of thousands of acres. Such fire events usually follow windstorms, pest epidemics, or occur during dry weather in very crowded stands. Proactive management has kept these fires to a minimum in the North and South in recent decades.

Minimizing losses from catastrophic winds and other "natural" events: Not all adverse impacts to forests from catastrophic events can be avoided. The adverse impacts to forests include loss of habitats, loss of timber, erosion, and secondary catastrophic events (e.g., fires after windstorms, insect and disease epidemics; landslides following fires or windstorms; insect outbreaks following fires or windstorms; reburning in dead trees several years after a fire). Consequently, there is a desire to avoid the secondary catastrophes by proactive recovery.

Sustaining the global environment

Increased awareness of the "planet Earth's" interrelation of climate, pollution, and socioeconomic events throughout the world has led to the concern that maintaining values in one part of the world should not be done by degrading values elsewhere. Such "exporting" of environmental problems has been referred to as the "NIMBY" behavior ("Not In My Back Yard"), or "environmental imperialism." Two major concerns relative to the global environment are:

--that practices in the United States do not increase air pollution--especially global carbon dioxide; and,

--that protection of forests in the United States does not increase liquidation (unsustainable harvest) of forests elsewhere, especially in countries which have limited experience with managing forests on a sustainable basis.

Avoiding atmospheric carbon dioxide (CO2) and other pollutant buildup: Increases in atmospheric CO2 for the past several decades have raised concerns in the international scientific community, including the prospect of global warming, extreme weather events, and rapid climate changes. The United States has instituted a 1994 Climate Change Action Plan to reduce CO2 emissions by target amounts. Significant changes such as major forest mortality, catastrophic wildfires, or sea level rise could be enormously disruptive to the atmosphere on the local or regional scale. There are concerns about other atmospheric pollutants (e.g., ozone, sulfur dioxide, nitrogen oxides) that parallel the concerns about atmospheric CO2.

The primary source of increased atmospheric CO2 in the United States is the burning of fossil fuels. There are four ways that forests can contribute to the reduction of atmospheric CO2 buildup:

1. Growing forests remove CO2 from the atmosphere and store it in wood and soil organic matter. Increasing the rate of forest growth, extending the harvest age, and expanding forest area through reforestation of marginal crop and pasture lands hold considerable opportunity to enlarge the contribution of forests to the mitigation of atmospheric CO2 buildup. A “steady-state” forest (a very old forest where as much wood is rotting as is growing) does not remove CO2, but its high wood volume stores much CO2 and thus keeps it from the atmosphere.

2. Wood products, particularly those used in buildings and other structures, extend the storage of forest-grown carbon long after timber harvest. Even paper products and wood stored in dumps and landfills have storage lifetimes that can extend for several decades. Sustainably-grown forests, harvested on a periodic basis will continue to sequester and store atmospheric carbon into the foreseeable future if the wood is efficiently utilized.

3. Wood and wood byproducts can replace fossil fuels to meet energy demands, so sustainably-grown forests represent a neutral CO2 impact on the environment, since the carbon is replaced at the same rate it is released. This allows fossil carbon to remain stored as coal or petroleum,

so it represents a net decrease of CO2 released to the atmosphere from industrial activities.

4. Concrete, steel, aluminum, or brick release much more CO2 in their mining, manufacture, transport, and fabrication than wood, so utilizing timber products as construction materials represents a reduction in the industrial emissions of CO2.

5. Forests cannot store CO2 as biomass indefinitely, however, and eventually forest biomass will be recycled into the atmosphere by either biological decomposition or fire. Forests where fire was the primary carbon recycler (because of dry or cold climates that limit biological activity) can build enormous stores of dead and living biomass under active fire suppression but, if the excess wood is not removed by harvest, it must eventually burn. An alternative is to harvest trees before they succumb to natural events and to use the wood in structures or other uses which sequester carbon and substitute for more fossil fuel-consuming materials.

Conserving native forests in other countries: There is a global harvest and trade of forest products which responds to increases and decreases in harvests in various countries (Perez-Garcia 1993). Increases or decreases in timber harvest in the United States can cause offsetting responses in other countries. United States' laws and policies that require forest harvests to ensure protection of other forest-based values are generally stronger than in other countries. Reductions in timber harvest in the United States may lead to accelerated harvesting in these countries and a corresponding impact on forest values abroad.

Ensuring plant and animal survival and diversity

Plant and animal species have periodically become extinct in historical and prehistoric times. There is concern that human actions do not accelerate the rate of species extinction. Presently, there are many species in each region of the United States which are considered threatened with extinction or have greatly reduced populations.

There are five general concerns associated with preventing animals and plants from becoming extinct and sustaining native diversity:

Conserving and restoring native forest types and species: Forests of similar species occupy similar soil, climatic, and geographic niches. These forests of similar species have been defined as “types.” Some plant and

animal species are dependent on certain forest types. There is concern that some of these forest "types" are disappearing.

Some species, e.g., American chestnut, have been decimated by pests or other causes, but are not considered to be endangered. There is concern that these species will not be restored to forest ecosystems, despite the possibility of controlling the cause of decimation or developing resistant plants. Restoration of a forest type, without its complement of associated species, would be incomplete.

Providing habitats for native species within forest types: Ensuring that all forest stand structures are maintained within a forest area can help ensure that associated plant and animal species do not become threatened and endangered. Different forest species live in different stand structures and combinations of structures (Figure 1.3). Species or populations can become extinct when the forests do not contain enough of each structure (Oliver and Larson 1996).

Ensuring survival and recovery of threatened and endangered species: Once a species is identified as threatened or endangered, there is concern that the targeted species be allowed to recover and restored to its habitats.

Protecting native species from invasive exotic species: Invasive exotic plants, such as multifloral rose (Rosa multiflora), kudzu (Pueraria lobata), and Japanese honeysuckle (Lonicera japonica), displace native plants. The exotic species can quickly dominate an area, affecting reproduction potential and, eventually, the ability of native plants and dependent animals to survive.

Maintaining genetic diversity and architecture: Maintaining genetic diversity and local genetic architecture within a species is a concern when forests are artificially regenerated. Certain populations, often isolated, may contain unique or rare alleles. Eliminating these populations through land conversion to non-forest uses or harvesting can occur without threatening the species with extinction, but their loss represents a diminution in genetic diversity that may be a concern. Artificial regeneration with trees of the same species, but from a non-local seed source, may change both the local genetic diversity and architecture. There is concern that these alterations could have long-term ramifications in terms of survival and productivity.

There is concern about planting of genetically engineered genotypes of native plant species created through gene splicing. Such planting raises the possibility of introducing alien genes into the local gene pool unless appropriate cautions are taken.

Ensuring productivity of future forests

Balancing between providing values for the present generation and leaving options for future generations to achieve their values has been stated as "sustainable development" (United Nations, Brundtland Report 1987). Different forest conditions can limit or expand the ability of future generations to achieve their values at different times and to different degrees. There are several components of "sustainability".

Degrading soil productivity can limit the rate of forest tree growth for hundreds of years, and thereby, reduce future options. Elimination of standing forests (through harvest, fire, or pests) can limit future availability of wood and habitat for many decades, if proper regeneration and management practices are not implemented. Pest epidemics can limit future options to grow forests for a few decades, without proper control/eradication measures.

Some components of sustainability have been previously listed as values; three other components of "sustainability" will be individually considered here:

Maintaining site quality: Site quality is the growth potential of a given area through a combination of soil condition and climate. If the site quality is not maintained, the ability of forests to grow and provide the various values is reduced.

Sustaining watersheds: If watersheds are impacted to the extent that soil erosion is increased above normal geologic rates, the quality and periodicity of water will be adversely affected. This will affect the ability to support people and aquatic and riparian species.

Maintaining the forest land base: The ability of forested lands to provide various values on a sustainable basis is dependent on the land base not being converted to other uses, such as agriculture, housing and urban areas, or grazing lands.

II. VALUES EXPRESSED AS CONTRIBUTIONS TO THE QUALITY OF HUMAN LIFE (BUT NOT LISTED ABOVE (TABLE I.1B).

Many forest conditions described in Part I contribute to the human quality of life. In addition, other values derived from forests contribute to the human quality of life:

Timber products

Timber products from harvested trees provide a variety of values including lumber for construction, paper, plastics, and fuel. If used appropriately, these timber products provide inexpensive, environmentally sound substitutes for steel, concrete, aluminum, and brick (as described in Part I). There are three aspects of the ability of the forest to provide the timber products:

Timber volume: Future forests will need to provide even more timber than current production to meet the needs of an increasing human population, including residential and urban construction, paper products usage, and other forest products needs.

Timber quality: High quality wood products, such as high quality construction products, need trees of certain characteristics.

Lumber made from "juvenile wood"--approximately the first 15 to 20 years of growth at the centers of trees--is generally weaker, more knotty, and often warped. This lumber is generally not as suitable for high quality products. Consequently, trees harvested when young (on "short rotations") contain more of this juvenile wood and so do not have the innate wood quality that older trees have. Large diameter trees often contain more volume of wood outside of this juvenile center than smaller diameter trees even in trees of the same age. The characteristics needed for high quality wood have traditionally included large diameter trees that are straight, free of rot, and with small or no knots (living or dead branches). Technology can overcome some, but not all, of these quality problems.

Selected species: Certain tree species are more valuable than others for commodities because of innate characteristics and technology limitations. As a general rule, conifers (softwoods) have historically been more valuable for construction than broadleaf (hardwood) trees. Hardwood timber has dominated markets for furniture, cabinets, flooring, and other products for which appearance is of principal importance. In recent decades, technological developments have allowed substitution of hardwood timber for some uses previously provided by softwoods.

Non-timber, non-wildlife products

Forests provide non-timber commodities such as floral greens, berries, mushrooms, medicinal herbs, pharmaceuticals, and others. Native animals (non-game), particularly reptiles and amphibians, are often removed for the pet trade or zoos. Other animals, such as earth worms and “lady bugs”, are often sold commercially for a variety of purposes.

Reserve areas[1]

Some people desire forested areas "free from the obvious hand of humans," i.e., areas relatively free of commodity production. Various forms of these reserves exist on both public and private lands. Examples are National and State Parks, Wilderness Areas, Research Natural Areas, Withdrawals by the Northwest Forest Plan, Nature Conservancy properties, and small "wilderness" areas designated on forest industry lands. Generally, development and management activities that affect native plant and animal life are not permitted on these reserves.

Recreational opportunities

Forests provide recreational opportunities in two forms:

Remote - recreational opportunities away from roads.

Accessible - recreational opportunities readily accessible by roads.

Rural lifestyles

Two types of rural lifestyles are based on the forests and associated resources:

Commodity-dependent lifestyles: People with this lifestyle rely on being able to earn income from products obtained from the forest. These lifestyles are oriented around and dependent upon receiving income from extracting such commodities as timber.

[1] Areas such as National Parks and Wilderness Areas which are characterized by excluding (or essentially excluding) commodity use--especially timber management and harvest--are referred to in this report as “reserve areas”, as is done by the USDA Forest Service RPA. This term is nearly the opposite of the original term “reserves”, which referred to areas to be managed as forests for both commodities and non-commodities. “Preserves” has also been suggested; however, this term implies that the areas will be remain unchanged (preserved). The forest will always change, even without commodity production; and areas excluded from human activity will develop dramatically differently than they have during human habitation of the past 10,000 years or more.

Non-commodity-dependent lifestyles: People with this lifestyle rely on the forest existing in an aesthetically pleasing condition that provides a wide array of recreational opportunities. They earn their income from recreation, earn their income elsewhere (e.g., high technology), or are retired but choose to live in forest areas.

Earnings, employment, and value-added

The capacity of the forests to support economic activity can be divided into several aspects:

1. Infrastructure: A complex socio-economic system such as the United States contains many economic segments. No segment constitutes a high proportion of the nation's workforce, and elimination of any single segment can be considered to have a relatively insignificant impact on the national employment ("The tyranny of small numbers.").

   As a corollary, the economy as a whole is dependent on a relatively small number of people in each economic segment to maintain a social infrastructure. Consequently, a relatively small shift in the workforce can have a large impact on the socio-economic system as a whole. (For example, the air traffic controllers at United States airports are an extremely small proportion of the nation's workforce. However, if their number were reduced, the nation's economy would be dramatically affected.)

   The forestry infrastructure in the United States consists of forest administrators and managers, forest products processors, and providers of recreation opportunities. They ensure the ability of the forest to provide various values.

2. Earnings: The income generated and passed to the employees and owners by an economic segment sets the standard of living which that part of society enjoys. Consequently, economic segments which have high earnings contribute strongly to the whole society's standard of living.

3. Employment: There is concern about the opportunity for gainful employment in the United States, especially with the recent welfare reforms. Forestry has and can be used as a means of employment in forest management (at technical and physical levels), forest product processing, and recreation. The jobs range dramatically in skill and pay. The nature of forestry has allowed many forestry jobs to be used as "counter-cyclic" employment--opportunities for work during times of job shortages. Unemployment levels are often quite high in rural areas, and often quite seasonal, so forestry sector job opportunities are important.

4. Value added: If a product or service provides the opportunity to add value by further input (e.g., secondary manufacture), provision of the original good or service can greatly increase the economic activity within a region and beyond. Both forest products and recreation have "value-added" capabilities.

Water volume and usefulness

An important value from many forests is to provide water of appropriate amounts, qualities, and flow conditions to sustain commodity and non-commodity uses. This was one of the justifications for establishing some National Forests. Forests serve as watersheds and to protect against floods. The vegetation can both filter water and moderate the flows, to help moderate the extremes of floods and no flow.

Game and non-game fish and wildlife

Forest-associated habitats are necessary for many wildlife and fish species sought by hunters and fishermen. Additionally, forests shelter non-game species (e.g., birds) that are important to food chains and to certain citizen groups.

Economic viability of private forest landowners and forest products and recreation segments.

For the private forest landowners and the forest products and recreation industrial segments to continue to provide various forest values, they must remain economically viable segments of the economy. Viability here means a mixture of profitability (to continue operation), availability of the factors of production (raw materials, labor, infrastructure, etc.), and volume of production (to provide more than a “unique token” of commodities to society).

The people and businesses that depend on the forest for economic activity are highly diverse. Forest conditions or policies that benefit one segment may not benefit another segment. Lumping these very different interests into one category (i.e., “the industry”) can lead to serious misperceptions of the demands the different segments place on forests and the values that they prize. For this paper, the segments will be divided as follows:

Small private, non-industrial landowners: These landowners have diverse objectives for forest land management. Whereas they generally take advantage of timber harvest to produce income, their harvest and management is often influenced by such factors as providing cash flow,

pleasing aesthetics, and tax payments (e.g., estate taxes), rather than maximizing the economic present net worth.

Private, industrial landowners: These landowners generally manage their lands to provide maximum profitability--either directly from the forests or by providing cheap raw material to their mills.[1]

High-volume timber products manufacturers: These mills generally produce paper, construction lumber, and wood composites in high volumes for general consumption. They are dependent on uniform species, high volumes, and moderate quality. The economies of scale generally mean large companies and relatively low employment per volume of production, but the employees are paid high wages.

Products manufacturers utilizing specialty timber: These mills generally produce high quality, specialized products such as furniture, doors, musical instruments, and specialized beams for construction. They are dependent on moderate volumes of high quality wood of selected species, often hardwoods in the North and South and conifers in the western regions. Although some of these products are beginning to be made from small diameter, low quality timber in high-volume manufacturing facilities, there is still a large economic segment which utilizes and provides products from the high quality timber in more labor-intensive manufacturing. The need for attention to detail generally means small companies with relatively high employment per volume of production, and the employees are generally paid high wages.

The recreation industry: The composition of this industry is varied. It generally provides equipment and services for hunting, fishing, camping, hiking, and other forest-related activities. This industry usually provides high employment, but low wages, because of its service-based nature.

Low public costs of managing forest lands

There is concern about the costs of managing public forests since the costs are borne by a combination of taxes and income generated by the forests. The costs of catastrophic events on public and private lands is often borne by

[1] The RPA assessment defines "forest industry" lands as those "owned by companies or individuals operating wood-using plants." A new class is arising of corporations who do not own wood-using plants (or treat them as a separate "profit center") but otherwise own extensive holdings and manage them for profit to the shareholders. For this discussion, these owners are considered as "forest industry" (e.g., in Appendix C).

the public in the form of emergency relief and recovery funds, as well as by the public loss of life and property. Fire fighting costs are also a concern on public forest lands.

Other costs include funding administration and management of public forests, payment to local governments instead of taxes on public forest lands, and funding unemployment and other relief when forest policies shift and jobs are eliminated.

There are also public costs of public assistance to private, non-industrial landowners. This assistance is usually provided by state forestry agencies and county extension services in the forms of information, maps, and various cost-sharing programs.

An additional concern is that tax revenue and employment be generated by economic activity in the private and public forest sectors.

Scenic, existence and historical values

Forests provide non-commodity values such as aesthetics and landscapes that portray the historical conditions of native forests. Forest plants and animals often have value as components of forests even if they have no commercial values. These organisms directly or indirectly contribute to food chains, habitats etc. of more commercially prominent plants and animals. The physical existence of forests is also important to many urban people who may never visit a forest. Other people enjoy both special features and landscape patterns of certain forests for their historical value.

Spiritual and cultural values

Certain forested areas and forest plant and animal species hold a spiritual meaning to some people. For example, the Black Hills region is considered a holy place for Native Americans belonging to certain Great Plains tribes, e.g., Lakota (Sioux). Some tree species (e.g., western redcedar) are considered to have significant cultural value for other American Indians. Many cultures have special, non-secular connections with forests in all the regions.